PATENT SPECIFICATION

628,752

Application Date: Nov. 7, 1947. No. 30555/46.

Complete Specification Accepted: Sept. 5, 1949.

Index at acceptance:—Class 39(i), D10f.

COMPLETE SPECIFICATION

Improvements in or relating to Magnetrons

We, THE M-O VALVE COMPANY LIMITED, of Brook Green, Hammersmith, London, W.6, a British Company, and ALFRED WILLIAM BALLS, of Research Laboratories of The General Electric Company Limited, Wembley, Middlesex, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to resonant cavity magnetrons, and especially, but not exclusively, to resonant cavity magnetrons of the solid metal block anode type.

The anode blocks used in known solid anode block magnetrons are usually perforated by a cylindrical hole providing an electron orbit space and have recesses forming resonant cavities extending radially into the block from the cylindrical surface of the hole, the mid-plane between the sides of each cavity lying substantially parallel to the axis of the hole and the shape of each cavity in sections at right angles to the axis of the hole being usually rectangular or rectangular with a circular enlargement at the end away from the axis; the cathode is usually of cylindrical shape and located coaxially within the said hole. Here and hereinafter the word "axis" always means the longitudinal axis.

The cavities may be coupled by metal straps joining alternate segments between recesses and may all lead into a single channel extending round the block perpendicular to the said axis for the purpose of combining and leading away R.F. power from the cavities, but nevertheless each cavity functions effectively as a separate resonator and this sometimes leads to difficulties in respect of mode changing; in addition it makes difficult the provision of any arrangement for tuning the magnetron over an appreciable range of frequencies, since each cavity must be individually tuned.

To overcome these difficulties there has already been proposed, for example in Patent Specification No. 574,551, a form of magnetron in which there is effectively only a single resonant cavity surrounding the electron orbit space and opening on to it in the form of a circumferential slot, and having interlaced fingers extending from opposite sides of the slot to define the electron interaction regions. The object of this invention is to provide an improved magnetron of this known form.

It will be appreciated from what follows that the construction in accordance with the invention may readily be applied to the solid anode block form of magnetron, but that it may also be applied to give a form of magnetron in which the anode consists of a thin-walled hollow resonator similar to those used in velocity modulation valves.

According to the invention, a magnetron comprises an anode in the form of a toroidal hollow resonator, which resonator surrounds an electron orbit space in which is located an electron emissive cathode, the wall of the resonator bounding the said space is perforated by a slot which extends round the space, a plurality of conductive fingers, each connected to a side of the slot, are spaced apart round the slot and each extends across the slot towards, but out of contact with, the other side of the slot, the fingers being interleaved and adjacent fingers being connected to different sides of the slot, and the length of each finger extending across the slot is so small compared with the internal circumferential distance round the wall of the resonator from one side of the slot to the other that the operating frequency of the magnetron is substantially independent of the lengths of the fingers. It will be understood that the statement that the fingers are connected to the sides of the slot includes the case where the fingers are formed integral with the wall of the resonator.

With a magnetron of this form the hollow resonator is adapted to be multiply

[Price 2/-]

excited by the passage of electrons past the plurality of pairs of adjacent fingers. By making the length, i.e. extension across the slot, of the fingers so small compared with the internal circumferential distance round the wall of the resonator from one side of the slot to the other that the operating frequency of the magnetron is determined mainly by the dimensions of the resonator and is substantially independent of the length of the fingers, the possibility of mode changing may be substantially eliminated, or at least considerably reduced, since the wave-lengths of the possible modes of resonance will be more widely separated.

The operating frequency of magnetrons of the form with which this invention is concerned may readily be altered by means which effectively alter the resonant frequency of the hollow resonator; thus, for example, the magnetron may be arranged to be tuned over a range of frequencies by means of an adjustable plug adapted to be screwed into or out of the resonator.

The principles of the construction of the anode of a magnetron in accordance with the invention are illustrated in the accompanying drawing, which shows a schematic perspective view of one suitable form of anode.

The anode comprises an annular cylindrical hollow resonator 1 which surrounds a cylindrical space 2 in which the cathode is adapted to be inserted along the axis, this space providing the electron orbit space. The inner wall 3 of the resonator is perforated by a narrow slot 4 which extends round the space 2. Across the slot 4 extend, each parallel to the axis, a plurality of short conductive fingers 5, each of which is integral with the inner wall 3 of the resonator at one side of the slot and extends nearly, but not quite, to the other side, adjacent fingers extending from opposite sides of the slot.

The outer wall 6 of the resonator is perforated by a hole 7 through which a coupling loop (not shown) for extracting energy is adapted to be inserted, and by a further hole in which is fixed a bushing 8 through which a tuning plug 9 can be screwed into or out of the resonator.

It will be appreciated that an anode construction of this kind lends itself readily to fabrication in the solid metal block form; thus the block may conveniently be made in two halves adapted to fit together in a plane perpendicular to the axis of the electron orbit space, each half of the block providing half of the cavity of the resonator and half of the said slot round the inner wall.

Each half of the block will also carry half of the said plurality of fingers which may be fixed in position before assembly so that the fingers interleave when the two half blocks are fitted together; the fingers may be formed integral with the material of the half blocks or separate fingers may be welded or screwed to the half blocks.

It may be noted that the fingers need not necessarily be of rectangular strip shape; and thus in the case of solid anode block magnetrons it may be convenient for the fingers to be of appreciable thickness i.e. in the dimension measured radially from the axis of the anode, and of triangular section in planes perpendicular to the said axis.

It will be appreciated that the hollow resonators in the anodes of different magnetrons in accordance with the invention may have different shapes in sections by planes containing the axis of the electron orbit space, especially when the anode is of the solid metal block form; thus for example each part of the section across the toroid may be rectangular or circular or rectangular on the side nearer the axis and terminated by a circular enlargement on the side further from the axis.

It will also be appreciated that the output may be taken from a magnetron in accordance with the invention in various ways, for example by means of a coupling loop projecting into the said resonator or by means of an opening from the resonator into a wave-guide, or by means of a connection to one of the said fingers.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A magnetron comprising an anode in the form of a toroidal hollow resonator, which resonator surrounds an electron orbit space in which is located an electron emissive cathode, wherein the wall of the resonator bounding the said space is perforated by a slot which extends round the space, and wherein a plurality of conductive fingers, each connected to a side of the slot, are spaced apart round the slot and each extends across the slot towards, but out of contact with, the other side of the slot, the fingers being interleaved and adjacent fingers being connected to different sides of the slot, and wherein the length of each finger extending across the slot is so small compared with the internal circumferential distance round the wall of the resonator from one side of the slot to the other that the operating frequency of the magnetron is substantially independent of the lengths of the fingers.

2. A magnetron according to Claim 1 wherein the said hollow resonator is formed by a cavity in a solid metal block.

3. A magnetron according to Claim 3 wherein the metal block is formed in two halves fitted together along a plane at right angles to the axis of the resonator about which the toroid is formed, each half block providing one half of the cavity of the resonator and half of the said slot, and each half block carrying one half of the said plurality of conductive fingers.

4. A magnetron according to any preceding claim comprising tuning means for altering the resonant frequency of the resonator for adjusting the operating frequency of the magnetron.

5. A magnetron according to Claim 4 wherein the said tuning means comprises a plug adapted to be screwed into or out of the resonator.

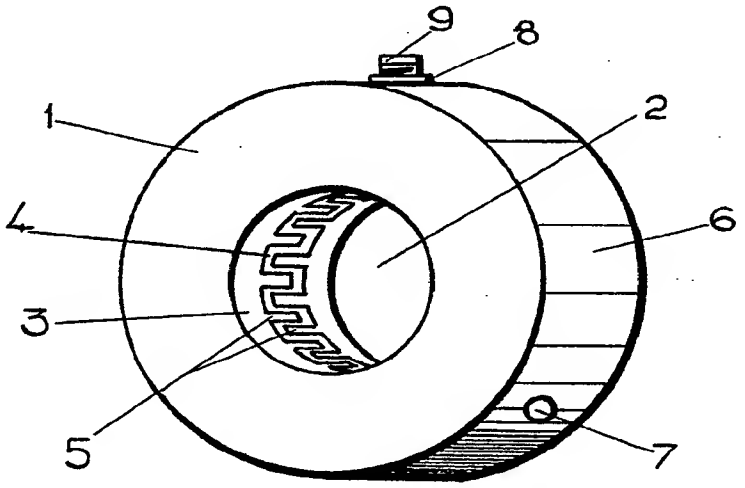
6. A magnetron having an anode which is substantially as shown in and herein before described with reference to the accompanying drawing.

Dated the 7th day of November, 1947.

For the Applicants,
W. J. C. CHAPPLE,
Chartered Patent Agent.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1949.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 2s. 0d. each (inland) 2s. 1d. (abroad) may be obtained.

[This Drawing is a reproduction of the Original on a reduced scale.]



H.M.S.O.(Ty.P.)